MOOSE IN THE NORTHWEST TERRITORIES - A DISCUSSION PAPER

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ABSTRACT

Moose management in the Northwest Territories has not been intensive, and no attempts have been made to consolidate the information available on this species. This report discusses the status of NWT moose on an area-by-area basis. Factors which are considered include habitat characteristics, moose densities and productivity, and harvesting rates. Although relatively little information is available, it appears that moose populations in the Liard Valley and the Slave River Lowlands are declining. Those in the Mackenzie Delta and the Yellowknife area are subject to high harvesting levels despite their low densities. The status of moose in other parts of the NWT is uncertain. It is recommended that the above areas and the lower Mackenzie Valley receive a higher priority via a more intensive moose management program for the NWT.

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INTRODUCTION

Moose (*Alces alces*) are one of the most important species of wildlife in the Northwest Territories (NWT). They provide about 30% of the fresh meat available to communities below the tree line (Brackett et al. 1985). They also supply clothing and handicraft materials. In the Liard Valley moose are the most significant wildlife resource to the local people, with each animal valued as high as $2,000 (Decker and Mackenzie 1980). The potential value of moose to Mackenzie Valley residents has been estimated at $2.4 to $6.24 million annually (NWT, Science Advisory Board 1980).

Although moose are important from an economic, social and cultural perspective, they have not received as much attention as high priority species like caribou and polar bear. Moose management in the Territories has not been intensive, and no management units for moose have been delineated. Some of the information required to manage moose is not available. One major problem identified by studies to date is the lack of adequate harvest data, particularly from holders of General Hunting Licences (GHL's) (see Hawley and Antoniak 1983). There is also concern that some populations may be overharvested (Hawley and Antoniak 1983, Walton-Rankin 1977, Stewart 1980). Overhunting has been known to contribute to declines in moose populations in other parts of Canada (see MacLennan 1974). If a similar situation exists in parts of the NWT, a more active moose management program should be considered.

It is the intention of this report to review the information available on moose in the NWT in order to begin discussions concerning the current priority which moose receive within the Wildlife Management Division. The factors affecting moose are different in various parts of the Territories. The status of the resource and concerns for its management will be considered on an area-by-area basis.

BACKGROUND

Distribution

In the NWT moose are found in all forested areas south of the tree line (Fig. 1). On the tundra, small concentrations of moose may be found in areas of lush willow growth (Britton 1983). In the region north of the tree line, moose have been shot at Chesterfield Inlet, Baker Lake and Eskimo Point (Stephen 1972), and they have been hunted near Coppermine for years (Britton 1983).

Habitat

Moose prefer early successional forests, and fire has been responsible for sustaining much of the present moose habitat in the NWT (Usher 1977, Krefting 1974, Watson et al. 1973). The optimal successional stages for moose are thought to occur between 11 and 30 years after burning (Kelsall et al. 1977). Successional habitat associated with rivers is also important. The quality of moose habitat in the NWT varies widely, depending upon the factors which influence the habitat in an area. Habitat evaluations have been largely subjective, and were based primarily on the degree of successional change characteristic of a region. Many important areas for moose have been identified (Fig. 1). Most of these sites represent winter range, since little is known about seasonal movements or summer habitat preferences of moose in the NWT.

Habitat selection in winter is thought to be influenced by depth and quality of snow, as well as forage availability (Gill

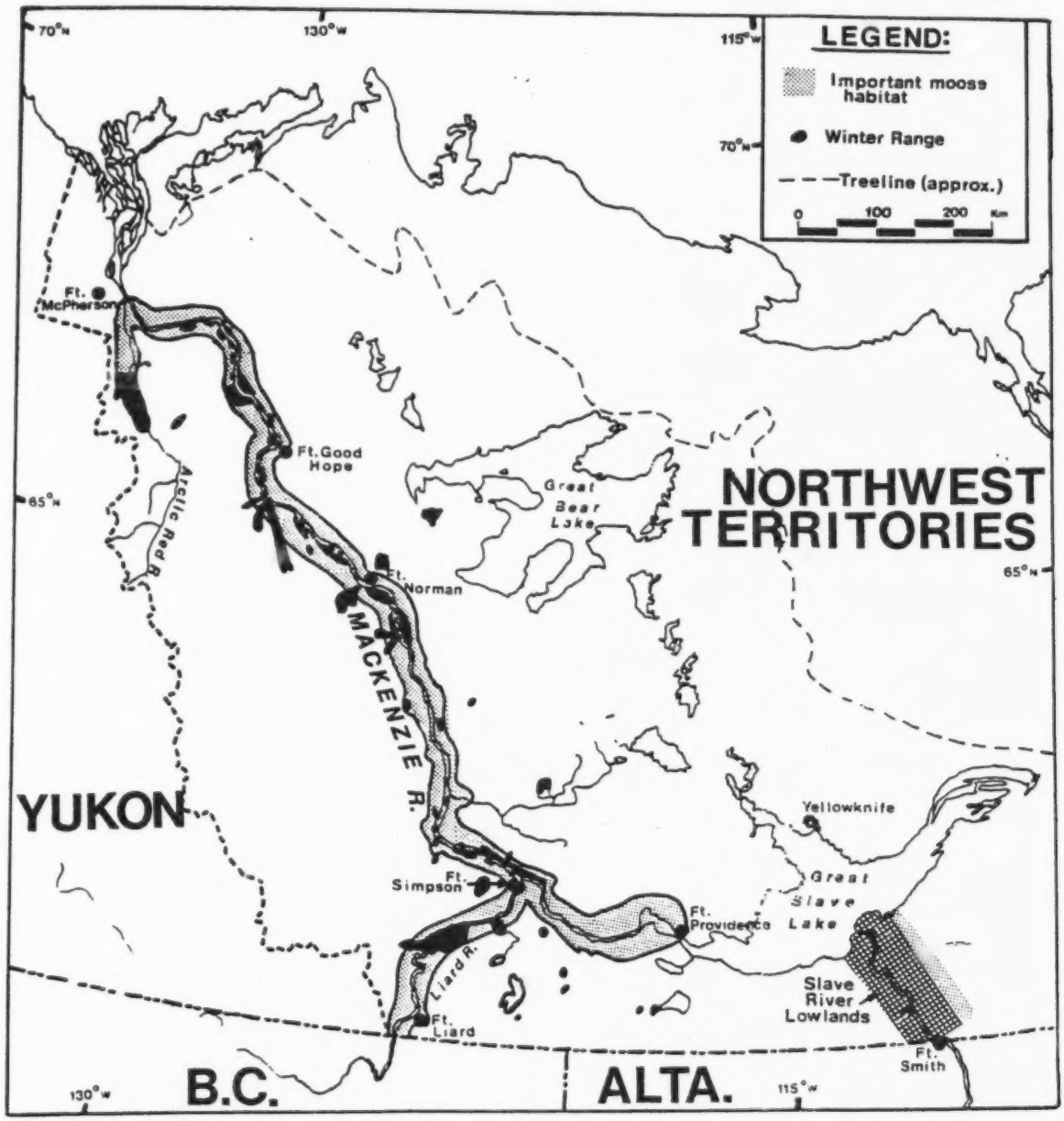

Figure 1. Important moose habitat in the Northwest Territories.

The tree line represents the approximate limit of moose distribution in the NWT. Habitat evaluations have not been conducted in some areas (e.g., the Mackenzie Mountains). Source: B. Decker, pers. comm.

1978, Krefting 1974). Wintering sites may support the entire moose population from a region five to ten times as large as the wintering area itself (Watson et al. 1973). For this reason, moose wintering areas are considered important to the maintenance of a population.

Densities

Moose densities in the NWT are low compared to those in other parts of North America (Table 1). Average densities in the Territories range from 0.03 to 0.09 moose/km^2. This is at least ten times lower than in Manitoba, Saskatchewan and Alberta, and up to one hundred times less than on the Kenai Moose Range in Alaska. Climatic factors could be responsible for the low moose densities within the NWT. Moose generally exist in a state of negative energy balance throughout the fall, winter and early spring (MacLennan 1974). The severe climate of the NWT may compound the problems of winter survival, acting as a constraint on moose reproductive potential (Dickinson and Herman 1979).

In this report, an arbitrary definition of densities is used for comparison purposes. Densities are classified as follows:

0.03 moose/km^2 or less = low

above 0.03/km^2 but less than 0.08 moose/km^2 = moderate

0.08 moose/km^2 or more = high.

Densities cited for particular areas are based on the average results of surveys to date. Moose densities within an area are

Table 1. Moose densities outside the Northwest Territories.

Area	Density ($moose/km^2$)	Date	Source
Manitoba			
- Riding Mountain National Park	1.00	February 1976	Carbyn 1977
Saskatchewan			
- weighted average	0.38	January - February 1963	MacLennan 1974
	0.51	January - February 1968	
	0.26	January - February 1973	
Alberta			
- Sand River Valley	0.81	March 1976	Usher 1977
	0.25	December 1976	
Northeastern Minnesota	0.78	December 1969	Peek et al. 1976
Alaska			
- Yukon River Flats	0.17	March 1962	Evans et al. 1966
- Kenai National Moose Range	1.47	November 1965	Evans et al. 1966
- Tanana Flats area	0.06 - 1.48	November 1978	Gasaway et al. 1983

variable depending upon the time of year that surveys are conducted. Previous surveys have been hampered by the lack of consistent and accurate techniques. The density figures cited here must, therefore, be regarded as tentative. Reliable techniques are now available, and future efforts can be expected to yield better information on moose population parameters.

Population Dynamics

Moose populations have fluctuated widely throughout their circumpolar range (Dickinson and Herman 1979), but the magnitude of such fluctuations within the NWT is unknown. Virtually no information is available concerning moose population dynamics in the NWT. No attempts have been made to identify distinct populations, and it is not known to what extent NWT moose may be migratory. The factors which may limit moose populations are unknown, although predation by wolves, and to a lesser extent black bears, may be important in some areas (Donaldson and Fleck 1980, Wolfe 1974).

Moose can rapidly increase their reproductive rate if habitat conditions are favourable. Net productivity can approach 25 per cent on good range (Dickinson and Herman 1979). Therefore, moose are one of the most suitable species in the NWT to be managed through habitat manipulation. Habitat management efforts, however, are constrained by our lack of information concerning moose population potential.

To date, fall classification surveys have revealed calf-to-cow ratios of about 60:100 in the Slave River and Fort Good Hope areas, and 40:100 around Norman Wells. Late winter composition surveys have shown 13% calves in the Liard Valley and 11% calves in the lower Mackenzie Valley. A comparison with productivity data from other areas (Table 2) suggests that calf survival in the NWT is good until the fall/early winter. By late winter, however, the percentage of calves in NWT populations is low compared to that in other regions of North America. It appears that late-winter calf mortality may be a significant constraint on moose productivity in the NWT. This conclusion must be regarded as tentative as it is based on data from different parts of the NWT. Until the specific causes of this mortality are identified, the success of habitat enhancement programs is questionable. More information on moose productivity and population dynamics will be necessary in order to intensify management efforts in the NWT.

Harvesting

Unrestricted hunting of moose by GHL holders has been permitted for over 30 years. Prior to 1954, a quota of one bull moose per hunter was in effect. On 14 July 1954, the quota was raised to two bulls, based on surveys conducted in the Central Mackenzie area (Flook and Bryant 1957, Flook 1953). On 27 January 1955, the Game Ordinance was amended to allow the shooting, by GHL holders, of any number of moose of either sex and any age at any time of the year (Flook and Bryant 1957).

Table 2. Moose productivity outside the Northwest Territories.

Area	Time of year	Calves:100 cows	Source
Fall/early winter calf ratios			
Minnesota	December	47 av. (40-54)	Peek et al. 1976
Alaska	November	36.9 av. (15-58) before wolf control 54.5 av. (49-61) after wolf control	Gasaway et al. 1983[1]
Alberta (Swan Hills)	December	33	Lynch 1971

Area	Time of year	% calves	Source
Late winter/spring calf ratios			
Northeastern Alberta			
"Bitumount"	January 1976	30	Hauge and Keith 1981
	February 1977	22	Hauge and Keith 1981
	March 1978	18	Hauge and Keith 1981
"Syncrude"	February 1976	35	Hauge and Keith 1981
	February 1977	19	Hauge and Keith 1981
	March 1978	17	Hauge and Keith 1981
Alaska	May	20.4 calves/100 cows av. (6-34) before wolf control 39 calves/100 cows av. (25-53) after wolf control	Gasaway et al. 1983[2]

1 Only includes cows at least 30 months of age and is, therefore, an overestimate of productivity.

2 Only cows at least 36 months old; also an overestimate.

Harvest data based on GHL returns are shown in Figure 2. This information is not reliable; nonetheless, the harvest does appear to have declined substantially since the mid-1960s. The decreased harvest does not necessarily indicate a moose population decline. Factors such as an increase in the number of unreported kills and/or reduced overall hunting effort may be responsible for the lower reported harvest levels (NWT, Science Advisory Board 1980). Increased use of alternative meat sources may also be important in some areas (e.g., Bathurst caribou in recent years in the north and south Slave areas).

Resident hunters also hunt moose. The annual kill is estimated to be between 150 and 200 animals. Resident hunting pressure per area, based on 3 years of data, is shown in Figure 3. This is assumed to be fairly representative of locations frequented by resident hunters. Sport hunting by non-residents is confined to the Mackenzie Mountains, and is discussed later.

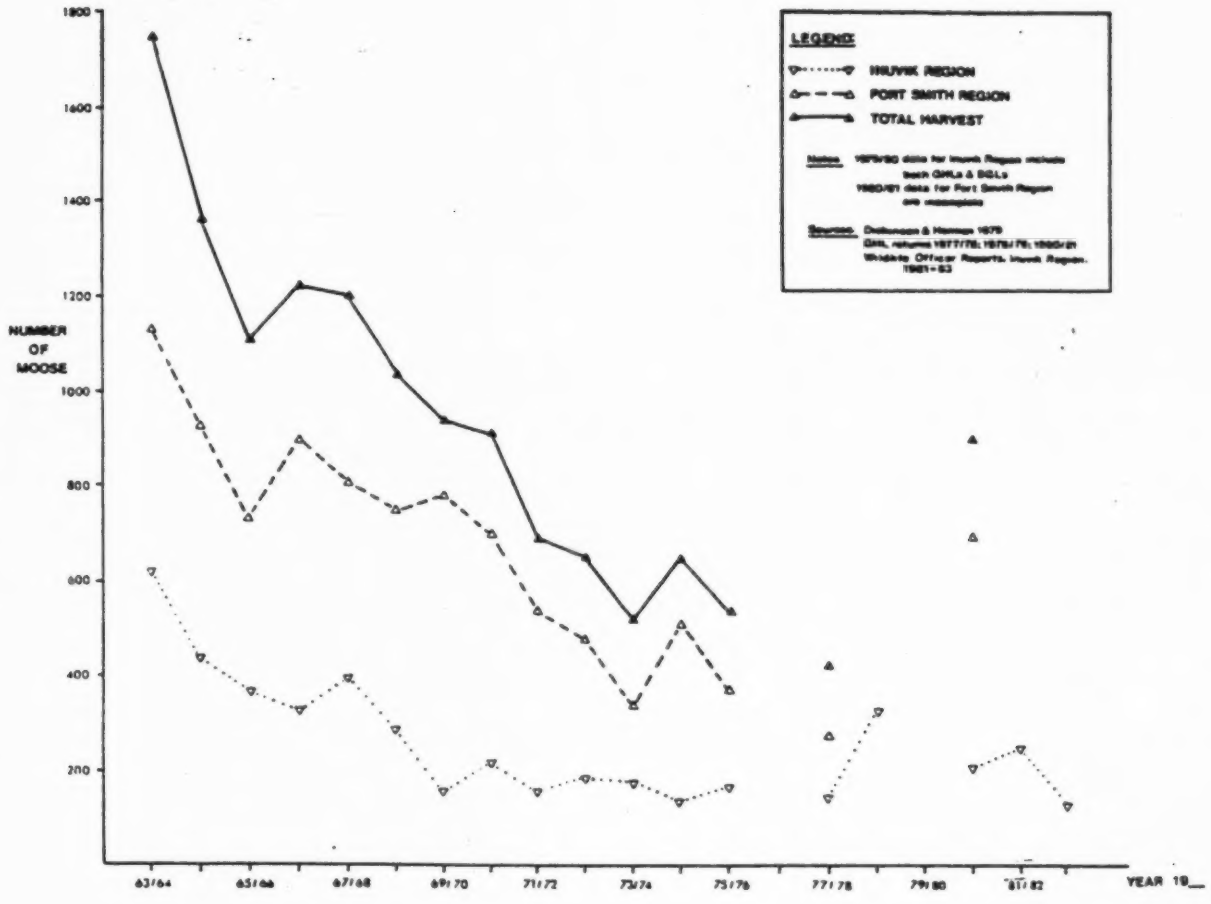

Figure 2. Moose harvested by General Hunting Licence holders, 1963/64 to 1982/83.

The return rate for GHLs is variable; thus the decreased harvest may not reflect declining moose populations.

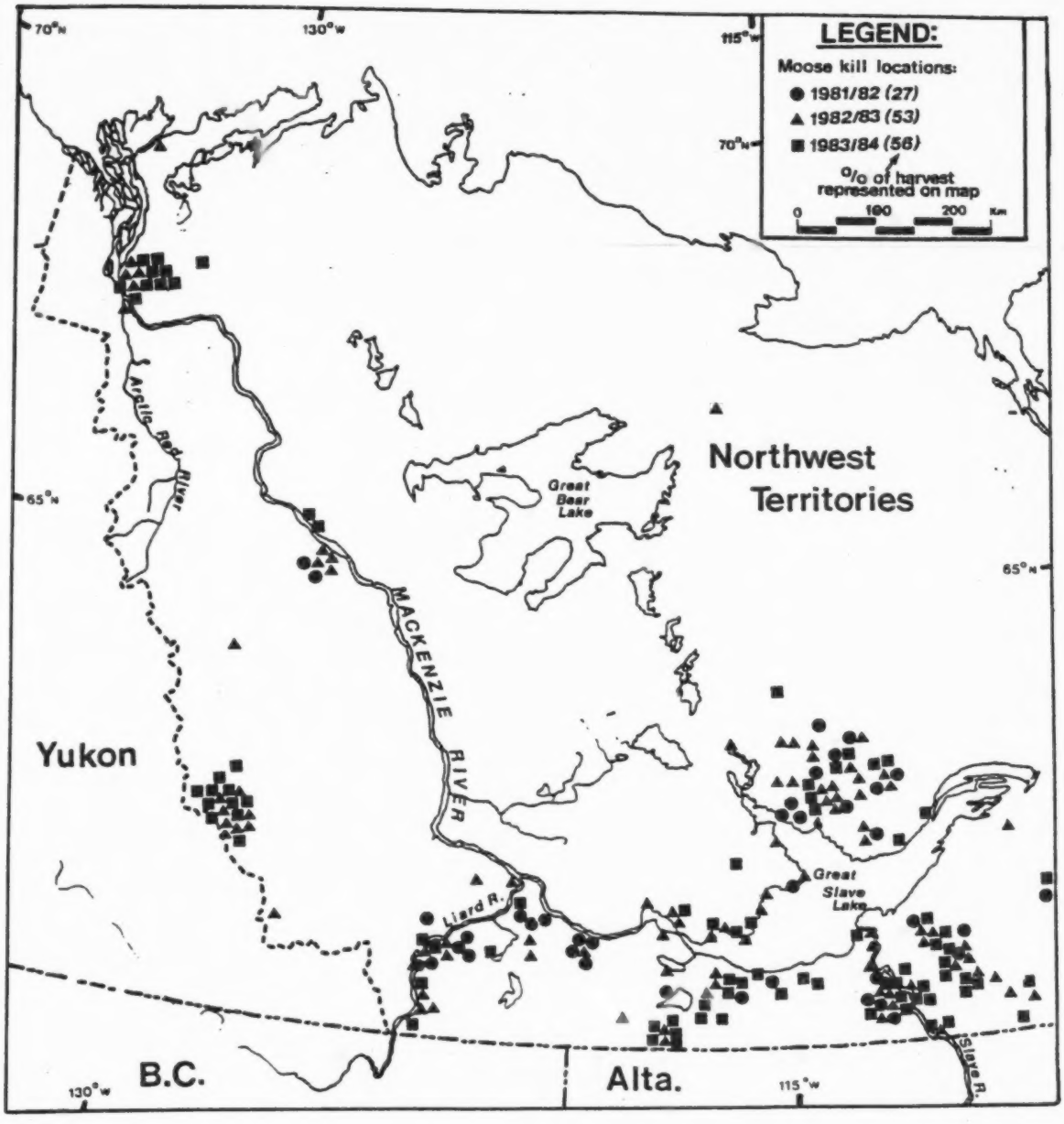

Figure 3. Distribution of moose kills by resident hunters, 1981-1984.

The percentage of kills was obtained by dividing the number of kill locations on the map by the total estimated harvest.
Source: Resident hunter questionnaires.

DISCUSSION

Liard Valley

The islands and shores of the Liard River and its tributaries provide widespread habitat for moose. The three main sources of browse are early successional growth following fires, riparian thickets and wetland shrub communities (Donaldson and Fleck 1980). Fires are most effective in creating new habitat for moose. This is especially true in uplands and other areas where habitat disturbance is less frequent. However, in the Liard Valley virtually all forest fires are suppressed. This policy has been in effect since at least the 1950s (B. Bailey, pers. comm.), and there are concerns that it has led to a reduction of moose habitat (Donaldson and Fleck 1980, Decker and Mackenzie 1980). It has been suggested that a lack of fires causes moose to concentrate in alluvial areas, with low densities supported in the rest of the Valley (Donaldson and Fleck 1980).

Willow from riparian communities is a preferred food for moose, particularly in winter. Willow communities are maintained at an early successional stage by periodic flooding, ice scouring and sedimentation. Wetlands supply aquatic vegetation and are important in summer. High water levels and poor drainage keep the wetland vegetation at an early successional stage.

Moose densities in the Liard Valley are high by NWT standards. Surveys have indicated an average density of 0.09 moose/km^2 (range 0.06-0.13) (Appendix A). The total moose

population in this area has been estimated to be at least 1094 (Hawley and Antoniak 1983). Recruitment rates in the Liard Valley are unknown, but the percentage of calves in February and March was estimated at 13.3% (Donaldson and Fleck 1980).

Hunting pressure in this area is fairly high. GHL returns from 1963/64 to 1975/76 indicate a minimum annual average harvest of 111, 27 and 74 moose from the communities of Fort Simpson, Nahanni Butte and Fort Liard, respectively (Dickinson and Herman 1979). This total harvest of 212 moose per year is consistent with the results of a survey by the Fort Simpson Hunters' and Trappers' Association. They estimated the average harvest over five years at 220 per year (Decker and Mackenzie 1980). Hunting pressure in the Liard Valley is probably somewhat lower than these figures suggest, as hunters, particularly those from Fort Simpson, kill moose in other areas. Resident hunting levels are also fairly high, particularly along the Liard Highway (Fig. 3).

Concerns

Moose populations in the Liard Valley have been reduced near the communities and in areas of ready access. Hawley and Antoniak (1983) report that some local hunters are concerned that moose are becoming scarce. Lack of fires and wolf predation have been cited as contributing to the decline. Decker and Mackenzie (1980) found no moose in areas of good habitat near the Liard Highway; their concerns regarding the impacts of improved access were echoed by local residents. According to Donaldson and Fleck (1980), the current harvest is double that which can be supported on a

sustainable basis. Available information on moose population dynamics suggests that the harvest may be exceeding productivity by as many as 75 moose per year (Hawley and Antoniak 1983).

Although many of the concerns raised about moose populations in the Liard Valley are based on sketchy information, it does appear that the population may be declining. Hunting restrictions have been in effect along the Liard highway since July 1983 (E. Bowden, pers. comm.). The 2 km-wide, no-hunting corridor applies to all hunters, and represents a significant cooperative venture in the wildlife management field. It is important that this cooperative spirit be preserved in future management efforts. Consultation with local residents is, therefore, a prerequisite for a more active moose management program in this area.

The consultation process may also lead to the identification of areas where habitat enhancement may be effective. The Liard Valley, because of its fire suppression regime, appears to be the area most in need of habitat alteration as a means of increasing moose populations. Fire suppression is in effect to protect merchantable timber and other resource values, and it is unlikely that fire would be an acceptable habitat management tool in this area. However, a number of other techniques are available, and the Department has formulated guidelines for the integration of forestry and wildlife management (B. Ferguson, pers. comm.). Cooperation from foresters will be necessary in order to apply these guidelines and improve moose habitat. If effective in this area, habitat enhancement techniques could be used as part of moose management programs in other parts of the NWT.

Slave River Lowlands

The Slave River Lowlands contain a variety of habitat types. Open prairies interspersed with aspen-willow copses and river systems bordered by spruce forests are characteristic of the central Slave Lowlands (B. Stephenson, pers. comm.). Muskeg is fairly common in the south, while much of the Delta is forested. Edges of sloughs, old channels and ponds, along with previously-burned sites are among the areas where moose forage may be found (Jacobson 1979, Kuyt 1963). Willows are abundant along rivers and lakes and on river islands (Reid, Crowther and Partners Ltd. 1982). Riparian vegetation, as in the Liard Valley, is maintained by periodic flooding and ice scouring. Sedimentation and fires are also important determinants of habitat type.

Although the Slave River lowlands contain good habitat for moose, densities here are considered only moderate. Six surveys have been flown in the area since 1971 (Appendix A). The average moose density was 0.05/km^2 and the total population was estimated at a maximum of 779 in 1982 (Hawley and Antoniak 1983). Composition surveys conducted in December 1981 revealed ratios of 120 males:100 females and 64 calves:100 females (Hawley and Antoniak 1983). These figures are fairly consistent with the results obtained by Kuyt (1963). He observed ratios of 113 males and 58 calves per 100 females in an intensive study of a small area in November.

Hunting pressure in the Slave lowlands seems to have increased in recent years, and is currently considered to be very high. Hawley and Antoniak (1983) estimate that in 1981/82, 147

and 115 moose were killed by GHL holders from Fort Resolution and Fort Smith, respectively. These harvest statistics are considerably higher than those obtained from GHL returns in the past, but are considered to be more reliable (for example, the moose harvest by Fort Resolution hunters was estimated to range from 40 in 1968/69 to 602 in 1973/74). It is assumed that the annual GHL harvest in the Slave River area is about 250 moose. Resident hunters are also quite active in this area, particularly near Grand Detour and along the Taltson River (Fig. 3). The open terrain and an abundance of waterways facilitate relatively easy access for all hunters.

Concerns

Hawley and Antoniak (1983) believe that moose are being overharvested in the Slave River area. They compare Jacobson's (1982) results from surveys in 1979, where densities of 0.11 moose/km^2 were found, to their own findings of 0.05 moose/km^2, and use this as evidence that population levels were higher in the past. They also use their composition data to calculate an annual calf production of 175 animals. This is greatly exceeded by the current harvest. Hawley and Antoniak's (1983) data suggest that 32% (250/779) of the moose population may be harvested annually. These concerns may be legitimate, but they have yet to be corroborated by local residents. It is possible that moose numbers in the Slave lowlands have been depleted, and that hunters from Fort Smith are now moving farther out onto the Shield in search of moose. Discussions should be undertaken with both

resident hunters and GHL holders in order to determine the extent of the problem in this area.

Mackenzie Valley

Fort Providence to Fort Simpson

The Mackenzie Valley provides widespread habitat for moose, but the quality of this habitat varies greatly along the river system. In the Fort Simpson area the habitat is generally quite poor. The river islands are well above the flood stage with steep, unvegetated banks (Walton-Rankin 1977). Most vegetation is in the climax stage, and as a result willows and other early successional species are not present. Small strips of riparian vegetation are found along many streams, and are enlarged or rejuvenated by fires (Watson et al. 1973). Most of the rivers in this area, however, are fast-flowing and do not provide browse along the banks for moose.

The area between Fort Simpson and Fort Providence, north of the Mackenzie River, is characterized by numerous shallow lakes, large bogs and extensive spruce and jackpine forests (Jacobson 1979). Recent fires have also occurred in this region. Browse is abundant around lake margins, and in general the habitat for moose is quite good.

The differences in habitat quality are reflected by the moose densities in these areas. Around Fort Providence, densities are high, averaging 0.09 moose/km^2 (Appendix A). Average densities in the Fort Simpson area are low at 0.03 moose/km^2. No information is available regarding other moose population parameters for these areas.

Hunting pressure along this part of the Mackenzie River is also variable. GHL returns from Fort Providence show an estimated annual harvest over 13 years of 65 moose (Dickinson and Herman 1979). This harvest level is increased by pressure from resident hunters, who kill moose in the Mackenzie Bison Sanctuary and along the Yellowknife highway (Fig. 3). It does not appear, however, that overharvesting is a problem in the Fort Providence region.

Along the Mackenzie River, the location and extent of the GHL harvest is unknown, since separate statistics for Jean Marie River are unavailable. Resident hunters previously concentrated their efforts along the Mackenzie highway, but a no-hunting corridor is now in effect. It is possible that problems could develop along the river just east of Fort Simpson. This area receives heavy hunting pressure (Prescott et al. 1973) which could, given the low moose densities, lead to a population decline. However, the proportion of the Fort Simpson harvest which takes place in the area is unknown, and there are no indications that local people are unhappy with the present hunting conditions. Thus, it appears that the upper Mackenzie River is not in need of intensive moose management at this time.

Fort Simpson to Fort Norman

Excellent moose habitat is found at various locations along this section of the Mackenzie River. The Martin River area just west of Fort Simpson and the islands around Camsell Bend and south of Fort Norman have been identified as prime moose winter range (Prescott et al. 1973). The river islands in this region are

subject to frequent disturbance from alluvial deposition, flooding and ice scouring. These processes maintain the early successional vegetation which is preferred by moose. A further attraction is the zonation of vegetation apparent on many islands. The riparian fringes are bordered by mixed forest and shrub communities, which in turn surround the interior spruce forests. This habitat provides optimum combinations of food and cover. The Martin River valley contains an active floodplain, which maintains the vegetation at an early successional stage. Habitat quality in this area is enhanced by relatively recent burns (Prescott et al. 1973). Other rivers on the west side of the Mackenzie, such as the Redstone, are characterized by frequent habitat disruption. Broad, shifting and braided river beds and frequent flooding are conducive to the growth of willows which provide good range for moose.

It is difficult to determine relative moose densities in this area, as few surveys have been conducted. Studies in the Wrigley area in 1979 and 1982 revealed densities of 0.03 moose/km^2 (Appendix A). In contrast, Walton-Rankin (1977) observed 0.8 moose/km^2 on islands between the mouths of the Keele and Redstone rivers. Although the latter survey was not systematic, it confirms the importance of wintering areas along the Mackenzie River. The contradictory survey results for this area suggest that moose densities are extremely variable. As in the upper Mackenzie region, other population parameters are unknown.

Harvest pressure in this area is generated almost exclusively by GHL holders. GHL returns indicate average annual kills of 70,

125 and 70 moose by hunters from Wrigley, Fort Norman and Fort Franklin, respectively (Dickinson and Herman 1979). Intensive hunting pressure is known to occur near Fort Norman, where moose "vacuums" have been apparent for at least 10 years (Prescott et al. 1973). These researchers also attributed low moose numbers in the Wrigley area to hunting by local people. The high harvesting rates of these communities are incongruous with the low moose densities reported for parts of the region. This discrepancy may be partially explained by the fact that some of the harvest takes place in the Mackenzie Mountains. It is also possible that moose densities are higher than estimated here. Since no problems are apparent in the area, it might be worthwhile in the future to conduct surveys and refine harvest data collection measures. This would allow a more accurate assessment of the status of moose in this area.

Fort Norman to Fort McPherson

The habitat features in this area are essentially the same as those described in the last section, but there is more high quality moose habitat along the lower Mackenzie River than along the upper regions. Essentially all of the islands between Fort Norman and Arctic Red River provide excellent moose winter range (Prescott et al. 1973). The island perimeters are regularly flooded each spring (Walton-Rankin 1977), and the mixed forest stands above the flood line supply abundant forage and cover. Many tributaries of the lower Mackenzie are similar in terms of habitat quality. Active floodplains, vigorous shrub growth on

eroded slopes and fire-originating tree growth are characteristic of the Carcajou, Mountain and Imperial rivers (Prescott et al. 1973). Wetland complexes and burned areas are fairly common, particularly around Fort Good Hope.

Moose densities in this area are among the highest in the NWT. In 1980, Brackett et al. (1985) found densities of 0.01 to 0.27 moose/km^2, with an average of 0.09 moose/km^2 over the entire area. The Peel and Arctic Red rivers supported densities of 0.13 and 0.17 moose/km^2, respectively. These latter results are inconsistent with those obtained by Hunter (1975), who found 0.02 moose/km^2 along the Arctic Red River. The difference is likely due to the more intensive method used in the later study. These figures also suggest that previous evaluations of the Peel River and Arctic Red River areas as poor moose habitat (Prescott et al. 1973) may have been inaccurate. The high moose densities in this region were confirmed by a 1984 survey of the Norman Wells and Fort Good Hope areas, where 0.14 moose/km^2 were observed (K. Jingfors, pers. comm.). November calf-to-cow ratios of 40:100 and 60:100 have been reported for the Norman Wells and Fort Good Hope areas, respectively (K. Jingfors, pers. comm.). The total moose population of the lower Mackenzie Valley has been estimated at a minimum of 1124 (Brackett et al. 1985), with calves comprising about 11% of the population in February.

About 200 moose are harvested each year in this region (Brackett et al. 1985). The bulk of this harvest occurs in the Fort Good Hope area, with Fort McPherson and Arctic Red River hunters each taking between 20 and 40 moose annually (based on GHL

returns). Resident hunters kill moose along the Canol road just west of Norman Wells, and non-resident hunting takes place in the mountains west of the river. Based on the figures cited here, the annual harvest represents 18% of the population (200/1124). This may exceed moose productivity in the area. Prescott et al. (1973) reported that moose numbers in the Norman Wells and Fort McPherson areas were severely limited by hunting. However, these concerns have not been repeated in recent years. Brackett et al. (1985) feel that moose numbers in the lower Mackenzie have been underestimated. Based on this, and on a lack of identified problems, it appears that moose numbers are adequate to sustain present harvesting levels.

This situation could change in the future. The Fort Good Hope HTA is interested in setting up an outfitting/tourism business in which moose hunting could play a major role. Harvesting could increase substantially once this business is established, and it is not known whether moose populations in this area can support higher levels of hunting. Population and productivity surveys should, therefore, be undertaken and discussions should be held with local residents, in order to answer this question before any outfitting business is established.

Mackenzie Delta

The habitat characteristics in this area include an abundance of shallow lakes and wetlands, patterned ground and other permafrost-related features, and forest cover dominated by scrubby

willows, alder and spruce (Prescott et al. 1973). Riparian vegetation dominates river channels, where frequent flooding and ice damage maintain the vegetation at an early successional stage. Browse for moose is abundant, but these same processes prevent the growth of mature forests (Walton-Rankin 1977). As a result, the Delta provides little or no cover for moose. Densities are extremely low, averaging less than 0.01 moose/km^2 (Appendix A). Brackett et al. (1985) found 0.10 moose/km^2 along the Miner, Smoke and Kugaluk rivers east of Inuvik. This density figure, however, is based on a survey of only the river valleys, and cannot be extrapolated to the area as a whole. The total moose population of the Delta has been estimated at 300 animals (Brackett et al. 1985).

The communities of Aklavik, Inuvik and Tuktoyaktuk annually harvest about 80 moose in total. Although the actual numbers of moose killed are low, hunting pressure is substantial given the minimal densities reported for this area. It is possible that about 25% (80/300) of the moose population may be removed annually by hunting. There were concerns in the past that local moose populations were being extirpated (Prescott et al. 1973); these have been neither confirmed nor refuted by local residents. The potential for overharvest appears to be substantial in this area. Discussions should be initiated with residents of the region in order to assess this potential.

Mackenzie Mountains

Virtually no information is available for moose in this part of the NWT. In the eastern Mackenzie Mountains, good habitat is

found in some of the river valleys. Alluvial floodplains, burned areas and eroded topography support the deciduous shrub growth which is utilized by moose (Prescott et al. 1973). Upland wetland complexes are important in summer, but their lack of cover makes them marginal for wintering moose populations. In the western ranges, moose have been reported to winter in riparian areas, but they may prefer more wooded areas in summer (Gill 1978). Lines (1971) points out that there are few lakes in the Mackenzie Mountains. This lack of aquatic vegetation may limit moose numbers in some areas. Because no comprehensive studies have been carried out, particularly in the western ranges, it is impossible to make general statements about the quality of moose habitat in the Mackenzie Mountains.

Average moose densities in this region are unknown, since no surveys have ever been conducted. Gill (1978) reports that moose numbers in the mountains increased between 1900 and 1944 and decreased thereafter, and that a "modest" population is now resident. The basis for these conclusions is unknown, and it is unlikely that Gill's findings can be applied to the entire Mackenzie range. Likewise, Gill's reported calf-to-cow ratio of 72:100 cannot be taken as representative, since it is based on an extremely small sample size.

Historically, the mountains were an important moose hunting area for native people, but the current levels of harvesting by GHL holders are unknown. People from Wrigley, Fort Norman and Fort Good Hope do use the river valleys in the eastern Mackenzies (Prescott et al. 1973), but the number of moose harvested there is

unknown. It seems likely that the island and shores of the Mackenzie River are currently preferred because of their much easier accessibility. The resident hunter harvest is minor and occurs mainly in areas of easy access, along the Canol and Nahanni Range roads (Fig. 3).

Non-resident hunting occurs in the interior ranges of the Mackenzies, and this is the only area in the NWT where these hunters may legally take moose. Data from outfitters indicate that overall hunting pressure is light, with an average of 27 moose per year taken between 1965 and 1983. However, sport hunting levels are by no means uniform. By far the bulk of the harvest has taken place in Outfitter areas E/1-2 to E/1-5, with areas E/1-3 and E/1-4 accounting for over 50% of reported kills (Fig. 4). The southern three Outfitter areas account for only 20% of the non-resident harvest. Communication with outfitters would be helpful in determining whether non-resident hunting pressure is reflective of moose population levels or if it is related to other factors such as clients' preferences or access problems.

Yellowknife Area

According to Jacobson (1979), there are two major habitat types in the Yellowknife area. The first is "Glacial Lake McConnell" which parallels the shore of Great Slave Lake and extends northwest to about Faber Lake. This habitat zone is approximately 40 km wide. In this area the Canadian Shield is overlain by lacustrine deposits from Glacial Lake McConnell (Craig 1965). Willow growth is abundant around lakes and ponds,

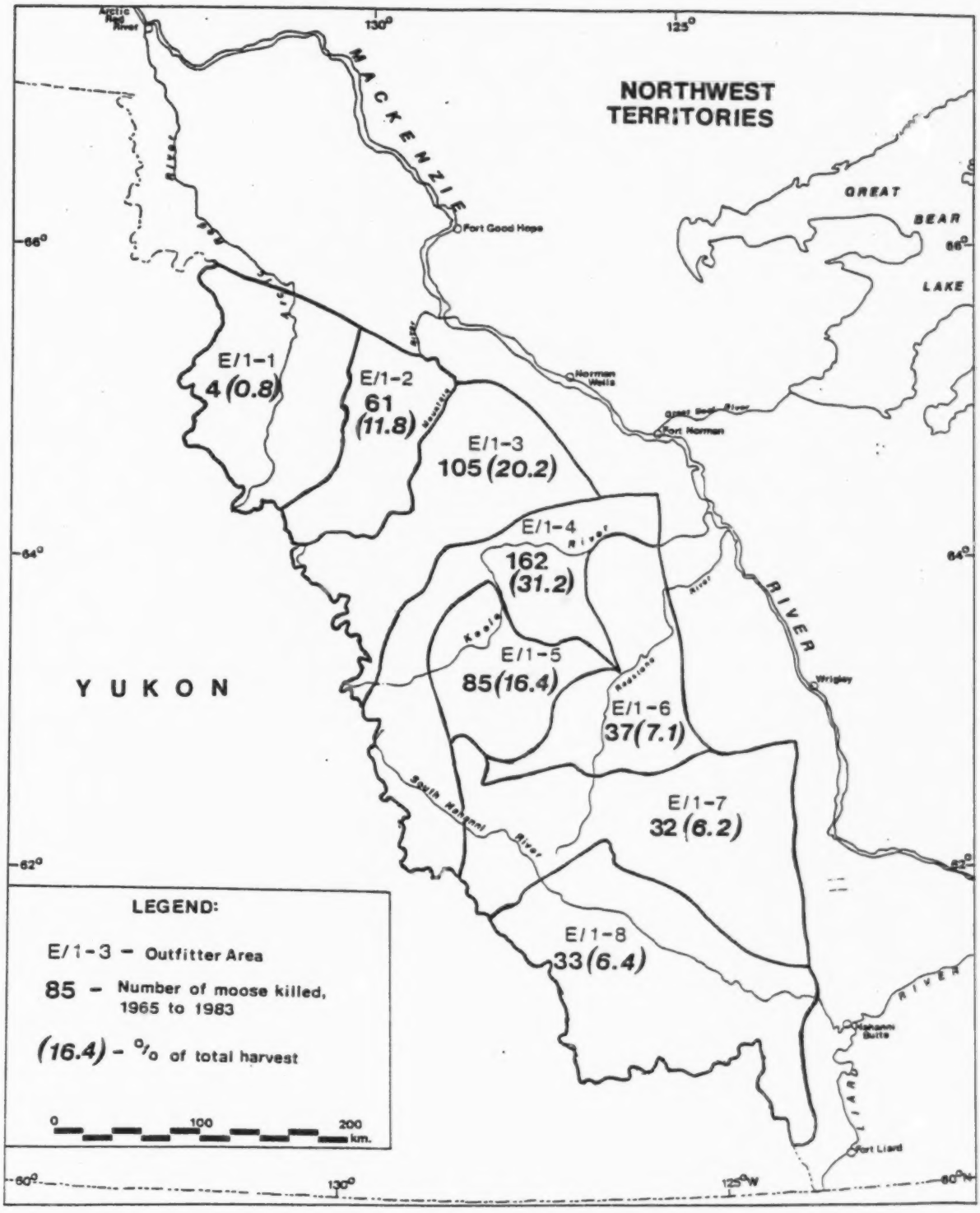

Figure 4. Non-resident harvest in the Mackenzie Mountains, 1965-1983.
Source: Outfitter reports.

providing excellent range for moose, especially in winter. North and east of this habitat zone is the "Open Forest" of the Shield. Deep, rocky lakes and fast-flowing rivers are characteristic of this area. Habitat for moose is thought to be of inferior quality (Jacobson 1979), although fires are likely important in maintaining some browse.

Survey data indicate that moose densities are low, averaging 0.03 moose/km^2 (Appendix A). They also reveal no apparent differences in habitat quality between Glacial Lake McConnell and the rest of the Shield. Density information is inconsistent with harvest statistics, which show that GHL holders from Rae take approximately 200 moose per year, more than any other community in the NWT. Yellowknife GHL holders take between 50 and 100 moose annually, and pressure from resident hunters in this area is probably the highest in the Territories (Fig. 3). Overall, it seems that moose populations in the Yellowknife area are subject to the most intense levels of hunting in the NWT.

Despite the high harvest, no apparent concerns have been expressed recently for this area, which may suggest that moose population levels have been underestimated. Additional surveys are warranted in order to discover whether this rate of hunting can be sustained.

CONCLUSIONS AND RECOMMENDATIONS

The current status of moose varies in different parts of the NWT. The estimated annual harvest is shown in Table 3, while Table 4 summarizes the specific measures recommended for each area reviewed. Although the overall status of moose in the NWT is uncertain, there are several facts which should be considered if one is to review the priority of the species:

1. We are harvesting about 1500 moose per year. This equates to approximately 300,000 kg of edible meat. At $10 per kg, the harvest is worth $3,000,000 without considering the value of hides and other economic spinoffs (Table 3).
2. We currently spend less than $30,000 per year on moose management programs.
3. We have several areas where the estimated harvest supposedly could not be sustained by the moose populations estimated for those areas. These areas are: the Liard Valley, the Slave River Lowlands, the Mackenzie Delta, and the Yellowknife area (Table 4).
4. We have at least one community, Fort Good Hope, that is interested in starting up an outfitting/tourism business based partly on moose.
5. We basically have no national or international concerns relative to this species.

Table 3. Estimated moose harvest. (Numbers given are maximum estimates for each region.)

Area	Estimated annual harvest	Source
Liard Valley	220	Decker and Mackenzie 1980
Slave River Lowlands	250	Hawley and Antoniak 1983
Fort Providence to Fort Simpson (Fort Providence only)	65	Dickinson and Herman 1979
Fort Simpson to Fort Norman	265	Dickinson and Herman 1979
Fort Norman to Fort McPherson	200	Brackett et al. 1985
Mackenzie Delta	80	GHL returns
Mackenzie Mountains	30	Outfitter reports
Yellowknife	275	GHL returns
Resident hunters	150	NWTWS Files
Total	1535	
		@ 200 kg/moose = 307,000 kg @ $10/kg = $3,070,000

Table 4. Status summary of individual moose populations.

Area	Moose population status	Recommendations
Liard Valley	declining	1,2,3,4,5
Slave River Lowlands	declining	1,2,3,4
Fort Providence to Fort Simpson	?	1
Fort Simpson to Fort Norman	?	1
Fort Norman to Fort McPherson	?	1,2,3,4*
Mackenzie Delta	low density and relatively high harvest	1,2
Mackenzie Mountains	?	1
Yellowknife Area	low density and high harvest	1,2

1 Collect better harvest data
2 Discuss status with community (users)
3 Conduct population surveys
4 Conduct productivity surveys
5 Investigate potential for habitat enhancement programs
* Necessary in order to determine whether outfitting can be supported.

The conclusions and recommendations presented here are based on the assumption that our harvest estimates are reasonably accurate. Although better harvest data are desireable for all areas, we feel that a review of moose management priorities should proceed regardless.

It is recommended that better harvest data be collected for all areas. Community consultation should be undertaken in the following areas:

- the Liard Valley
- the Slave River Lowlands
- the lower Mackenzie Valley (Fort Norman to Fort McPherson)
- the Mackenzie Delta
- the Yellowknife area.

Discussions with resource users will allow us to more accurately assess the current status of moose. They may also assist in the delineation of management units for moose, based on the concerns expressed in each area. Smaller management units will likely be necessary in order to address the specific moose management problems evident in each area. Our current Wildlife Management Zones are too large to be used as a basis for moose management decisions.

Population and productivity surveys are recommended for the Liard Valley, the Slave River Lowlands and the lower Mackenzie Valley. Habitat enhancement should be considered in the Liard Valley. The most immediate need is to assess both community concerns and the level of support for moose management programs. This will defer any immediate requirement for large expenditures on more active management measures.

The overall recommendation of this report is that moose should receive increased priority in the Inuvik and Fort Smith Regions.

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Appendix A. NWT moose survey results.

Area	Density ($moose/km^2$)	Month/ year	Source
Liard Valley			
	0.06	2/78	Decker and Mackenzie 1980
	0.13	1-2/79	Donaldson and Fleck 1980
	0.06	?/80	Hawley and Antoniak 1983
	0.11	?/81	Hawley and Antoniak 1983
Average	0.09		
Slave River Lowlands			
	0.25	11/63	Kuyt 1963[1]
	1.00	3/65	Malfair 1965[1]
	0.05	2/71	Rippin 1971a
	0.02	3/73	Manchur 1973
	0.11	3/79	Jacobson 1982
	0.05	3-4/80	Hawley and Antoniak 1983
	0.04	?/81	Hawley and Antoniak 1983
	0.05	2/82	Hawley and Antoniak 1983
Average	0.05		
Hay River Area			
	0.02	3/68	Colosimo 1968
	0.04	2/69	Lines 1969
	0.02	3/80	Chowns 1980
"Northern Alberta Forest"	0.13	3/79	Jacobson 1982
Pine Point	0.01	3/80	Stewart 1980
Average	0.04		
Fort Providence Area			
	0.07-0.09	11-12/71	Rippin 1971b
	0.11	3/79	Jacobson 1982
Average	0.09		
Fort Simpson Area			
	0.07	?/53	Flook 1953[1]
	0.05	winter 72-73	Slaney in Geddes and Duncan 1982
	0.02	12/75	Wooley and Wooley 1976
	0.01	2/76	Wooley and Wooley 1976
Average	0.03		

Appendix A. continued

Area	Density (moose/km^2)	Month/ year	Source
Wrigley Area			
	0.03	3/79	Jacobson 1982
	0.03	3/82	Hawley and Antoniak 1983
Redstone River to Keele River	0.80	3/73	Walton-Rankin 1977
Lower Mackenzie			
	0.01-0.27	2-3/80	Brackett et al. 1985
Average	0.09		Brackett et al. 1985
Norman Wells and Fort Good Hope	0.14	11/84	K. Jingfors, pers. comm.
Sans Sault Rapids	1.40	2/72	Walton-Rankin 1977
Hume and Ramparts Rivers	0.39	2-3/80	Brackett et al. 1985
Arctic Red River	0.02	3/75	Hunter 1975
Mackenzie Delta			
	0.009	2-3/80	Brackett et al. 1985
Inuvik	0.003	3/73	Strong 1973
Average	0.006		
Miner, Smoke and Kugaluk Rivers	0.10	2-3/80	Brackett et al. 1985
Yellowknife Area			
	0.23	?/62	Kuyt 1963[1]
	0.02	3/68	Lines 1968
	0.03	3/74	Baker 1974
"Glacial Lake McConnell"	0.03	3/79	Jacobson 1982
"Shield Forest"	0.02	3/79	Jacobson 1982
Average	0.03		

1 most dubious surveys; not included in average calculations.